

CLAIMS

1. A signal detection system that searches for a part of a stored signal similar to a target signal, comprising:

a stored feature calculation portion that calculates a stored feature from the stored signal;

a target feature calculation portion that calculates a target feature from the target signal; and

a feature comparison portion that calculates a degree of similarity using both a vector generated by degenerating the stored feature based on statistics of the stored feature calculated beforehand and a vector generated by degenerating the target feature based on statistics of the target feature calculated beforehand.

2. A signal detection server that searches for a part of a stored signal similar to a target signal input from a user terminal, comprising:

an user signal input portion that receives a target feature of the target signal from the user terminal;

a stored feature calculation portion that calculates a stored feature from the stored signal; and

a feature comparison portion that calculates a degree of similarity using both a vector generated by degenerating the stored feature based on statistics of the stored feature calculated beforehand and a vector generated by degenerating the target feature based on statistics of the target feature calculated beforehand.

3. A signal detection method that searches for a part of a stored signal similar to a target signal, comprising steps of:

a target feature calculation step that calculates a target feature

from the target signal;

a target statistics calculation step that calculates target statistics from the target feature; and

a feature comparison step that calculates a degree of similarity using both a vector generated by degenerating a stored feature based on statistics of the stored feature calculated beforehand and a vector generated by degenerating the target feature based on the target statistics.

4. A signal detection apparatus that searches for a part of a stored signal similar to a target signal, comprising:

a target feature calculation unit that calculates a target feature from the target signal;

a target statistics calculation unit that calculates target statistics from the target feature;

a stored statistics calculation unit that calculates stored statistics from a stored feature based on the stored signal; and

a feature comparison unit that calculates a degree of similarity using both a vector generated by degenerating the stored feature based on the stored statistics and a vector generated by degenerating the target feature based on the target statistics.

5. The signal detection system according to claim 1, which is a sound signal detection system that searches for a part of a stored sound signal that is the stored signal similar to a target sound signal that is the target signal having a shorter or same length as the stored sound signal, wherein:

the stored feature calculation portion that calculates the stored feature from time-series data of the stored sound signal;

the target feature calculation portion that calculates the target feature from time-series data of the target sound signal;

the sound signal detection system further comprising:

a stored feature area selection portion that calculates predetermined statistics from the stored feature, selects an element from the stored features corresponding to the statistics larger than a predetermined threshold, and calculates a stored area selection feature generated from a vector of the selected element; and

a target feature area selection portion that calculates predetermined statistics from the target feature, selects an element from the target features corresponding to the statistics larger than a predetermined threshold, and calculates a target area selection feature generated from a vector of the selected element, wherein

the feature comparison portion sets a comparison segment in the stored area selection feature, calculates a degree of similarity between the target area selection feature and the comparison segment of the stored area selection feature, repeats calculating while shifting the comparison segment one by one in the stored area selection feature, and searches for an area of the stored area selection feature similar to the target area selection feature.

6. The sound signal detection system according to claim 5, wherein:

the target feature area selection portion and the stored feature area selection portion, in order to obtain the statistics upon searching for an area, calculate average values of the elements respectively from neighboring feature vectors as the statistics upon selecting the area, select a area with a feature based on values calculated by subtracting the averages value from the elements respectively, and calculate an area selection feature made from a vector having values of the elements of the selected area.

7. The sound signal detection system according to claim 6 wherein:

the target feature area selection portion and the stored feature area selection portion calculate average values of the elements respectively from the neighboring feature vectors as the statistics upon selecting the area, select a point if an absolute value of a value by subtracting the average value from the element is larger than a predetermined threshold, and use an area selection feature generated from the value of the element of the selected point.

8. The sound signal detection system according to claim 6, wherein:

the target feature area selection portion and the stored feature area selection portion calculate average values of the elements respectively from the neighboring feature vectors as the statistics upon selecting the area, select one or a plurality of the elements from top with respect to absolute values of values by subtracting the average values from the elements, and use an area selection feature generated from vectors of the selected elements.

9. The sound signal detection system according to claim 5, further comprising:

a stored feature normalization portion that calculates predetermined statistics from the stored feature and other stored features neighboring the stored features at a sampling time, normalizes elements respectively in the vector of the stored feature, and calculates a stored normalized feature generated from a vector having elements of numbers calculated by normalizing; and

a target feature normalization portion that calculates predetermined statistics from the target feature and other target features neighboring the target features at a sampling time, normalizes elements respectively in the vector of the target feature, and calculates a target

normalized feature generated from a vector having elements of numbers calculated by normalizing.

10. The sound signal detection system according to claim 5, further comprising:

a user terminal that requests a search for the stored signal similar to the target sound signal; and

a signal detection server that searches for a part of the stored sound signal similar to the target sound signal having the shorter or same length as the stored sound signal, wherein:

the user terminal includes the target feature calculation portion and the target feature area selection portion; and

the signal detection server includes the stored feature calculation portion, the stored feature area selection portion and the feature comparison portion.

11. The signal detection server according to claim 2, which is a sound signal detection server that searches for a part of a stored sound signal that is the stored signal similar to a target sound signal that is the target signal input from the user terminal having a shorter or same length as the stored sound signal, wherein:

the user signal input portion of the user terminal comprises:

a target feature calculation portion that calculates a target feature generated from a feature vector from time-series data of the target sound signal; and

a target feature area selection portion that calculates predetermined statistics from the target feature, selects an element from the target features corresponding to the statistics larger than a predetermined threshold, and calculates a target area selection feature that

is the target feature generated from a vector of the selected element; the stored feature calculation portion that calculates the stored feature generated from a feature vector from time-series data of the stored sound signal;

the sound signal detection server further comprises a stored feature area selection portion that calculates predetermined statistics from the stored feature, selects an element from the stored features corresponding to the statistics larger than a predetermined threshold, and calculates a stored area selection feature generated from a vector of the selected element; and

the feature comparison portion that sets a comparison segment in the stored area selection feature, calculates a degree of similarity between the target area selection feature and the comparison segment of the stored area selection feature, repeats calculating while shifting the comparison segment one by one in the stored area selection feature, and searches for an area of the stored area selection feature similar to the target area selection feature.

12. The signal detection method according to claim 3, which is a sound signal detection method that searches for a part of a stored sound signal that is the stored signal similar to a target sound signal that is the target signal input from the user terminal having shorter or same length as the stored sound signal, wherein:

the stored feature calculation step that calculates the stored feature generated from a feature vector from time-series data of the stored sound signal; and

the target feature calculation step that calculates a target feature generated from a feature vector from time-series data of the target sound signal;

the signal detection method further comprising:

a stored feature area selection step that calculates predetermined statistics from the stored feature, selects an element from the stored features corresponding to the statistics larger than a predetermined threshold, and calculates a stored area selection feature generated from a vector of the selected element; and

a target feature area selection step that calculates predetermined statistics from the target feature, selects an element from the target features corresponding to the statistics larger than a predetermined threshold, and calculates a target area selection feature that is the target feature generated from a vector of the selected element, wherein

the feature comparison step that sets a comparison segment in the stored area selection feature, calculates a degree of similarity between the target area selection feature and the comparison segment of the stored area selection feature, repeats calculating while shifting the comparison segment one by one in the stored area selection feature, and searches for an area of the stored area selection feature similar to the target area selection feature.

13. The signal detection system according to claim 1, which is a sound signal detection system that searches for a part of a stored sound signal that is the stored signal similar to a target sound signal that is the target signal having shorter or same length as the stored sound signal, wherein:

the stored feature calculation portion calculates the stored feature from time-series data of the stored sound signal; and

the target feature calculation portion calculates the target feature from time-series data of the target sound signal;

the sound signal detection system further comprising:

a stored feature normalization portion that calculates

predetermined statistics from the stored feature, normalizes the statistics per the elements of the vector of the stored feature and calculates a stored area selection feature generated from a vector including elements of the normalized values;

a target feature normalization portion that calculates predetermined statistics from the target feature, normalizes the statistics per the elements of the vector of the target feature and calculates a target area selection feature generated from a vector including elements of the normalized values;

a stored feature quantization portion that calculates a stored quantized feature generated from elements calculated by quantizing the stored normalized feature; and

a target feature quantization portion that calculates a target quantized feature generated from elements calculated by quantizing the target normalized feature, wherein

the feature comparison portion sets a comparison segment in the stored quantized feature, calculates a degree of similarity between the target quantized feature and the comparison segment of the stored quantized feature, repeats calculating while shifting the comparison segment one by one in the stored quantized feature, and searches for an area of the stored quantized feature similar to the target quantized feature.

14. The sound signal detection system according to claim 13, wherein:

the feature vector is a vector including an element of a strength information per frequency sampled in a predetermined span; and

the statistics are an average value and a dispersion of the feature vector in the comparison segment.

15. The sound signal detection system according to claim 13, wherein:

the target feature quantization portion and the stored feature quantization portion apply a binary vector calculated by operating scalar quantization upon the elements of the normalized features using a predetermined threshold, as the quantized features.

16. The sound signal detection system according to claim 13, wherein:
the target feature quantization portion and the stored feature quantization portion apply a vector including signs as elements calculated by operating vector quantization upon the plurality of elements of the vector of the normalized features, as the quantized features.

17. The sound signal detection system according to claim 13, further comprising:

a user terminal that requests a search of the stored signal similar to the target sound signal; and
a signal detection server that searches for a part of the stored sound signal similar to the target sound signal having a shorter or same length as the stored sound signal, wherein:

the user terminal includes the target feature calculation portion, the target feature normalization portion and the target feature quantization portion; and

the signal detection server includes the stored feature calculation portion, the stored feature normalization portion, the stored feature quantization portion and the feature comparison portion.

18. The signal detection server according to claim 2, which is a sound signal detection server that searches for a part of a stored sound signal that is the stored signal similar to a target sound signal that is the target signal input from the user terminal having a shorter or same length as the stored

sound signal, wherein:

the user terminal comprises:

a target feature calculation portion that calculates a target feature generated from a feature vector from time-series data of the target signal that is a target sound signal;

a target feature normalization portion that calculates predetermined statistics from the target feature, normalizes the statistics per the elements of the vector of the target feature and calculates a target area selection feature generated from a vector including elements of the normalized values; and

a target feature quantization portion that calculates a target quantized feature generated from elements calculated by quantizing the target normalized feature, wherein

the stored feature calculation portion calculates the stored feature from time-series data of the stored sound signal;

the sound signal detection server further comprising:

a stored feature normalization portion that calculates predetermined statistics from the stored feature, normalizes the statistics per the elements of the vector of the stored feature and calculates a stored area selection feature generated from a vector including elements of the normalized values; and

a stored feature quantization portion that calculates a stored quantized feature generated from elements calculated by quantizing the stored normalized feature, wherein

the feature comparison portion sets a comparison segment in the stored quantized feature, calculates a degree of similarity between the target quantized feature and the comparison segment of the stored quantized feature, repeats calculating while shifting the comparison segment one by one in the stored quantized feature, and searches for an area of the stored

quantized feature similar to the target quantized feature.

19. The signal detection method according to claim 3, which is a sound signal detection method that searches for a part of a stored sound signal that is the stored signal similar to a target sound signal that is the target signal input from the user terminal having shorter or same length as the stored sound signal, wherein:

the stored feature calculation step calculates the stored feature from time-series data of the stored sound signal; and

the target feature calculation step calculates the target feature from time-series data of the target sound signal;

the sound signal detection method further comprising:

a stored feature normalization step that calculates predetermined statistics from the stored feature and other stored features neighboring the stored features at a sampling time, normalizes elements respectively in the vector of the stored feature, and calculates a stored normalized feature generated from a vector having elements of numbers calculated by normalizing;

a target feature normalization step that calculates predetermined statistics from the target feature and other target features neighboring the target features at a sampling time, normalizing elements respectively in the vector of the target feature, and calculates a target normalized feature generated from a vector having elements of numbers calculated by normalizing;

a stored feature quantization step that calculates a stored quantized feature generated from elements calculated by quantizing the stored normalized feature; and

a target feature quantization step that calculating a target quantized feature generated from elements calculated by quantizing the

target normalized feature, wherein

the feature comparison step setting a comparison segment in the stored quantized feature, calculating a degree of similarity between the target quantized feature and the comparison segment of the stored quantized feature, repeating calculating while shifting the comparison segment one by one in the stored quantized feature, and searching for an area of the stored quantized feature similar to the target quantized feature.

20. The signal detection apparatus according to claim 4, which is an image signal search apparatus searching for a stored image signal that is the stored signal similar to a target image signal that is the target signal, further comprising:

a target feature area selection unit that operates a threshold operation on the target statistics using a predetermined threshold, selects the target statistics and calculates a target area selection feature generated from a vector or a matrix including elements that are the selected target statistics; and

a stored feature area selection unit that operates a threshold operation on the stored statistics using a predetermined threshold, selects the stored statistics and calculates a stored area selection feature generated from a vector or a matrix including elements that are the selected stored statistics, wherein:

the feature comparison unit sets a comparison segment in the stored area selection feature, calculates a degree of similarity between the stored area selection features in the comparison segment and at least a portion of the target area selection feature, and repeats calculating the degree of similarity while shifting the comparison segment one by one.

21. The image signal search apparatus according to claim 20, wherein:

the target feature area selection unit and the stored feature area selection unit calculate average values of the stored feature and the target feature in a first predetermined time division, and select the element if an absolute value of a value by subtracting the average value from the element is larger than a predetermined threshold.

22. The image signal search apparatus according to claim 21, wherein:

the target feature calculation unit and the stored feature calculation unit calculate average values and standard deviations of the stored feature and the target feature in a second predetermined time division, and calculate the target statistic and the stored statistic by normalizing the target statistic and the stored statistic using the average value and the standard deviation.

23. The signal search method according to claim 3, which is an image signal search method that searches for a stored image signal that is the stored signal similar to a target image signal that is the target signal, further comprising the steps of:

a target feature area selection step that operates a threshold operation on the target statistics using a predetermined threshold, selects the target statistics and calculates a target area selection feature generated from a vector or a matrix including elements that are the selected target statistics; and

a stored statistics calculation step that calculates a predetermined stored statistics from the store features;

a stored feature area selection step that operates a threshold operation on the stored statistics using a predetermined threshold, selects the stored statistics and calculates a stored area selection feature generated from a vector or a matrix including elements that are the selected

stored statistics, wherein:

the feature comparison step that sets a comparison segment in the stored area selection feature, and calculates a degree of similarity between the stored area selection features in the comparison segment and at least a portion of the target area selection feature.

24. A computer program that operates a computer as the image signal search apparatus according to claim 20.

25. A computer readable medium that stores the computer program according to claim 24.

26. The signal detection apparatus according to claim 4, which is an image signal search apparatus that searches for a stored image signal that is the stored signal similar to a target image signal that is the target signal, further comprising:

a target feature normalization unit that calculates a target normalized feature using the target statistics and the target feature;

a target quantization unit that quantizes elements of the target normalized feature using a predetermined threshold, calculates elements of the target quantized feature and generates a target vector;

a stored feature normalization unit that calculates a stored normalized feature using the stored statistics and the stored feature; and

a stored quantization unit that quantizes elements of the stored normalized feature using a predetermined threshold, calculates elements of the stored quantized feature and generates a stored vector, wherein

the feature comparison unit sets a comparison segment in the stored vector, calculates a degree of similarity between the elements of the stored vector in the comparison segment and at least a portion of the elements of

the target vector, and repeats calculating the degree of similarity while shifting the comparison segment one by one.

27. The signal search method according to claim 3, which is an image signal search method that searches for a stored image signal that is the stored signal similar to a target image signal that is the target signal, further comprising steps of:

a target feature normalization step that calculates a target normalized feature using the target statistics and the target feature;

a target quantization step that quantizes elements of the target normalized feature using a predetermined threshold, calculating elements of the target quantized feature and generating a target vector;

a stored statistics calculation step that calculates stored statistics from the stored feature;

a stored feature normalization step that calculates a stored normalized feature using the stored statistics and the stored feature; and

a stored quantization step that quantizes elements of the stored normalized feature using a predetermined threshold, calculating elements of the stored quantized feature and generating a stored vector, wherein

the feature comparison step setting a comparison segment in the stored vector, calculating a degree of similarity between the elements of the stored vector in the comparison segment and at least a portion of the elements of the target vector.

28. An image signal search program that operates a computer as the image signal search apparatus according to claim 26.

29. A computer readable medium that stores the image signal search program according to claim 28.

30. The signal search apparatus according to claim 4, further comprising:

a target feature normalization unit that calculates a target normalized feature using the target statistics and the target feature;

a target area selection nonlinear quantization unit that inputs the element of the target normalized feature, calculates an element of a selected target nonlinear quantized feature, and generates a target vector;

a stored feature normalization unit that calculates a stored normalized feature using the stored statistics and the stored feature; and

a stored area selection nonlinear quantization unit that inputs the stored normalized feature, calculates an element of a selected stored nonlinear quantized feature and generates a stored vector, wherein

the feature comparison unit sets a comparison segment in the stored vector, calculates a degree of similarity between the elements of the stored vector in the comparison segment and at least a portion of the elements of the target vector, and repeats calculating the degree of similarity while shifting the comparison segment one by one.

31. The signal search apparatus according to claim 30, wherein

the target area selection nonlinear quantization unit and the stored area selection nonlinear quantization unit operate Voronoi tessellation upon a multi dimensional vector, and operate nonlinear quantization upon a distance from a Voronoi boundary surface to which the multidimensional vector belongs.

32. The signal search apparatus according to claim 30, wherein

the target area selection nonlinear quantization unit comprises:

a target feature area selection unit that selects elements corresponding to statistics larger than a predetermined threshold and

calculates a target area selection feature generated from a vector including the elements; and

a target feature nonlinear quantization unit that operates nonlinear quantization upon a feature vector.

33. The signal search apparatus according to claim 30, wherein the stored area selection nonlinear quantization unit comprises:
- a stored feature area selection unit that selects elements corresponding to statistics larger than a predetermined threshold and calculates a stored area selection feature generated from a vector including the elements; and
- a stored feature nonlinear quantization unit that operates nonlinear quantization upon a feature vector.

34. The signal search method according to claim 3, further comprising the steps of:

a target feature normalization step that calculates a target normalized feature using the target statistics and the target feature;

a target area selection nonlinear quantization step that inputs the element of the target normalized feature, calculates an element of a selected target nonlinear quantized feature, and generates a target vector;

a stored statistics calculation step that calculates stored statistics from the stored feature;

a stored feature normalization step that calculates a stored normalized feature using the stored statistics and the stored feature; and

a stored area selection nonlinear quantization step that inputs the stored normalized feature, calculates an element of a selected stored nonlinear quantized feature and generates a stored vector, wherein the feature comparison step that sets a comparison segment in the

stored vector, and calculates a degree of similarity between the elements of the stored vector in the comparison segment and at least a portion of the elements of the target vector.

35. A signal search program that operates a computer as the signal search apparatus according to claim 30.

36. A computer readable medium that stores the signal search program according to claim 35.

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